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# Intelligent Automation Incorporated

## Coherent distributed radar for high-resolution through-wall imaging

### Progress Report 18

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## Summary

In this period of performance, we are continuing to develop the hardware, and software for the final demonstration.

## 1.0 INTRODUCTION

In this report we discuss progress in radar design, software design, and simulations

### 1.1 Hardware build up

All hardware has been received, and we are now integrating two Synchronization transceivers.

### 1.2 Simulations

We are performing simulations to study use of wireless synchronization to improve ranging accuracy in the presence of multipath. Specifically, we are simulating RF ranging in a corridor, where the transmitter and receiver are located at the opposite ends of a 10m long, 5m wide corridor. The receiver moves across a 4m aperture, while recording waveforms. We use a Physic Optics (PO) model to calculate multipath scattering from wall. The LFM waveform has 50MHz of bandwidth @ UHF, and we assume 10dB SNR.

We use MUSIC to find the directions of different signals (LOS and multipath). After beamforming, we determine the range (is equivalent time of arrival for synchronized transceivers) of each signal. We assume the LOS signal corresponds to the signal with the minimum range.

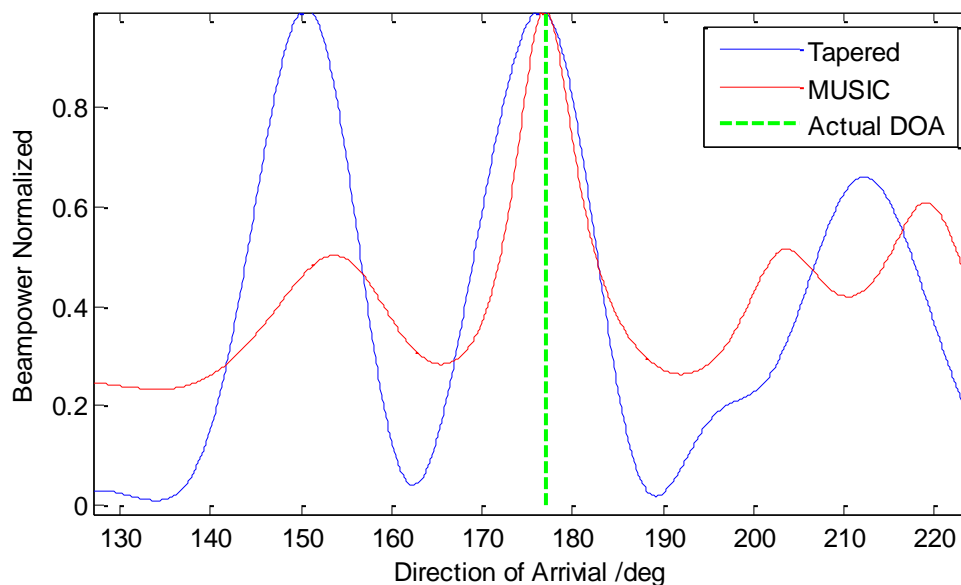


Figure 1. Beam forming results for tapered, and MUSIC.

The beamforming results show that MUSIC improves the DOA accuracy significantly.

## Estimation of range

In the figure below, we show the resulting range errors with and without beamforming. When we don't use beamforming, we simply average the ranges obtained at the different receiver locations. We find an error of approximately 74cm. With beamforming, we report the range corresponding to the estimated LOS DOA. In this case the error reduces to 5cm.

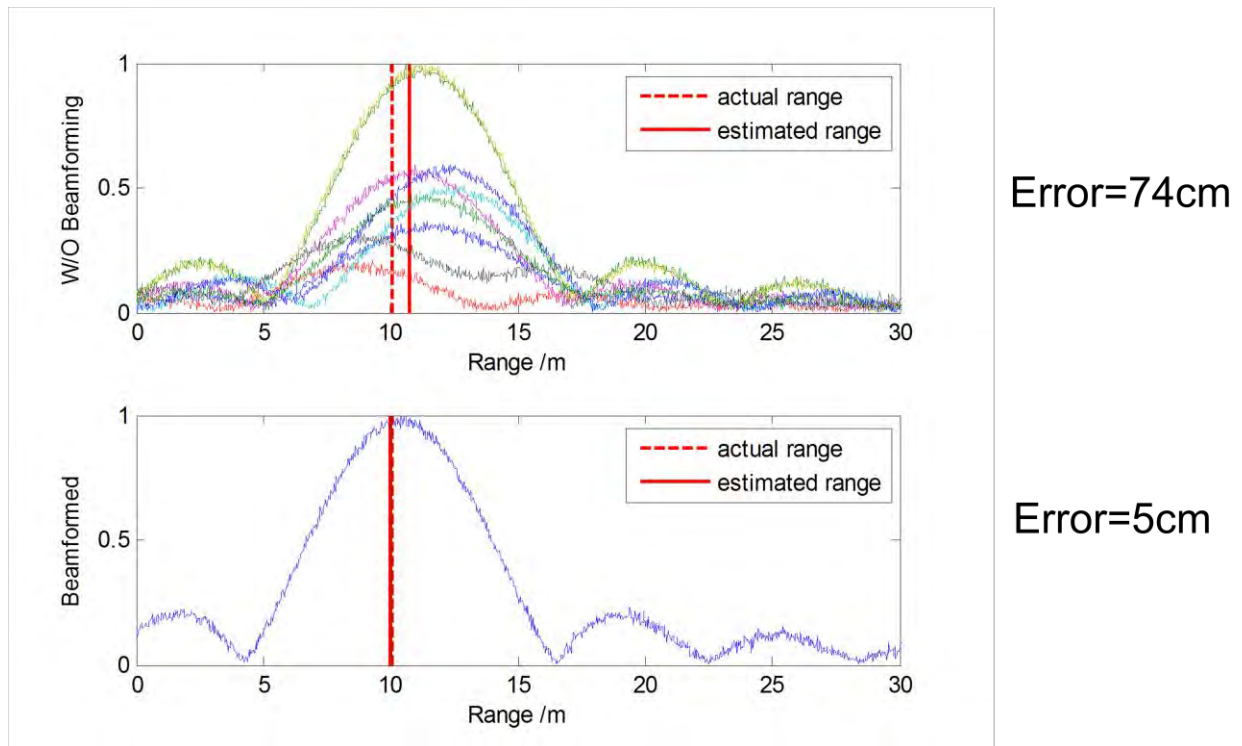


Figure 2. Range accuracy with and without beamforming.